Pesticide Air Initiative:
Strategy to Reduce Toxic and
Volatile Organic Compound Emissions from
Agricultural and Commercial Structural Pesticides

---Concept Paper---

The Department of Pesticide Regulation (DPR) has launched a comprehensive statewide initiative to improve air quality from pesticide impacts. The major emphasis of the Pesticide Air Initiative is to enact a regulatory framework that will exceed our commitment to reduce volatile organic compound (VOC) emissions from agricultural and commercial structural pesticides in nonattainment areas (NAAs), as outlined in the 1994 State Implementation Plan (SIP) and establish an element to California's new SIP.

The initiative targets reducing smog-producing chemicals from pesticide emissions in a way that will allow us to achieve our current state air quality goals by 2008. We will strive to reduce VOC emissions from pesticides in a way that also reduces pesticide toxic risk and drift. We believe that our pesticide air initiative will help California meet its future air quality challenges by providing the regulated community with viable options that will effectively reduce VOC emissions from pesticides.

The purpose of this paper is to outline actions we will take to meet our current commitment and to raise concepts that may be part of our future air quality goals. These concepts are not intended as official DPR proposals, but rather as concepts we are considering.

After we take into consideration comments on the Air Initiative, we will prepare a draft SIP for public comment. We expect to submit our new SIP commitment to the Air Resources Board for their consideration in early 2007.

While DPR understands that this effort to reduce VOC emissions presents some unique challenges, we will be able to protect our environment, health, enhance our economy, and create a model pesticide air program through an open and collaborative process.

Overview

VOCs and nitrogen oxides react with sunlight to create ozone, a major air pollutant. Many pesticide products contain chemicals that are VOCs and contribute to California's air quality problems. The contribution of pesticides to the emission inventory can range between three and eight percent and usually are among the top ten contributors. The Clean Air Act requires SIPs to reduce the emissions of VOCs and nitrogen oxides in

areas that do not meet the ozone standard. Under the 1994 SIP, DPR committed to reduce VOC emissions from agricultural and commercial structural applications of pesticides by specified amounts within specified time periods for five nonattainment areas (NAAs). Significant efforts are needed to meet the 1994 commitments, particularly in the San Joaquin, Ventura, and Southeast Desert NAAs. Our regulatory program will maximize VOC emissions reductions in these NAAs, and will generally apply throughout California.

Building upon the options outlined in the 1994 SIP, we have identified a realistic strategy to achieve reductions that are measurable and enforceable. In addition to the regulatory measures, our strategy will rely on both research and changes in pest management practices to reduce VOC emissions. While the more immediate short-term actions are intended to meet our existing commitment under the 1994 SIP, we have identified some concepts that may be incorporated into the new commitment we are developing.

As we look towards our developing our new SIP commitment, some significant challenges will need to be overcome to fully achieve the long-term air quality goals. Some of the concepts will require additional resources in terms of staffing and research. The technical feasibility of some concepts may take years to develop. Finally, the regulatory approaches needed to manage pesticide cumulative impacts may require additional statutory authorities or new ways of using existing statutes.

In preparing this strategy, we follow the same regulatory philosophy that brought successful auto emission reductions. In California, significant air emissions were achieved through cleaner burning gasoline and more efficient engines. This reduction approach allowed the air to be cleaner without limiting how and when people drove or fueled their vehicle. We believe that moving toward the increased use of lower VOC-containing pesticides (e.g., via reformulation and switching products) and the adoption of application practices that reduce emissions (e.g., pesticide use reduction, VOC degradation, adsorption) can bring significant reductions in an agronomic way. Through our various regulatory authorities, VOC emission reductions can be enacted that will be measurable and enforceable. Principally, reductions will come from the use of lower VOC containing products, reduction of VOC emission on a per acre basis, and application methods that reduce VOC emissions.

Drift and Toxic Exposures

DPR's integrated pesticide regulatory program continuously evaluates the impacts of pesticides on human health and the environment. Particular emphasis is placed on the protection of workers and communities from unacceptable pesticide toxic exposures. In approaching efforts to reduce VOC emissions from pesticides, careful consideration will be given to health risks. Moreover, since many of the strategies to reduce VOC emissions are compatible with reducing air toxin emissions, DPR will take steps to harmonize regulatory efforts related to pesticides in the air. In particular, regulatory measures developed under the Toxic Air Contaminant Act framework will be evaluated for reducing VOC emissions. Most immediately, we have broadened the mitigation efforts on methyl isothiocyanate (MITC) under the Toxic Air Contaminant Act to include

reductions of VOC emissions. Our regulatory package on MITC will include a broader set of restrictions limiting the VOC and toxic emissions from fumigants.

Strategy to Reduce Pesticide VOC Emissions
Our focus for reducing pesticide VOC emissions will be based upon reducing VOC emissions from traditional pesticide applications and shifting to agronomically viable, reduced risk pest control practices. To achieve these two goals, DPR will focus on reducing emissions from fumigants (which currently account for about one-fourth of all pesticide pounds applied annually); reformulating other pesticide products to reduce emissions and risks; promoting new, more environmentally friendly technologies; and developing strategic pest management partnerships in concert with the agricultural and commercial structural communities.

Our strategy will be grouped into four main areas:

- Fumigant Emission Reductions.
- Lowering Emissions from Liquid Emulsifiable Concentrates.
- Changes to Pest Management.
- Adoption of Innovative Technologies.

Program Goals and Accountability
In the near term, the implementation of this focused strategy will meet our existing SIP commitment to reduce VOC emissions from agricultural and commercial structural pesticides in NAAs by 2008. We are also developing a regulatory framework for future VOC emission reductions for the new SIP. We will build upon actions that have been initiated, as well as embark on measures that will be imposed over the next ten years. We can estimate reductions from the more immediate (within the next 18 months) regulatory measures. These more immediate reductions will meet our existing commitment and provide a base for the future. The reductions from future regulatory measures are difficult to quantify since many of them will require more evaluation, research, and program development. In preparing our new SIP commitment, we will ensure that future reductions can be measured and are enforceable.

For the more immediate reductions, we will impose regulatory actions needed to fulfill our existing SIP commitment.

- Lower the VOC content of most liquid emulsifiable concentrate pesticide products by imposing product reformulation requirements by the end of 2006 and establish regulations limiting the VOC content of products. Expected reductions will be approximately two tons/day based on the San Joaquin NAA.

- Impose fumigant regulations that will limit application practices in ways that reduce VOC and toxic emissions. Regulations will be proposed in 2007 and enacted in 2008. The fumigant regulations will result in approximately four tons/day based on the San Joaquin NAA.

Fumigant Emission Reductions

Background/Problem Statement
The options to reduce VOC emissions from fumigants present unique challenges. Although fumigants represent over 40 percent of the pesticide VOC emissions in the San Joaquin Valley and 80 percent or more for the Southeast Desert and Ventura NAAs, there are only five fumigants and each have distinct and specific pest control properties. Furthermore, fumigant products typically do not contain components other than the active ingredient, thus product reformulation to reduce VOC emissions is not an option.

Fumigants are usually applied at rates of several hundred pounds per acre, compared to a few pounds per acre for most other pesticides. This means that small proportional decreases in application or emission rates have a greater absolute effect on fumigant emissions. Reducing the rate of application for fumigants can achieve VOC reductions, but care must be taken to ensure that the reduced rate provides equivalent pest management efficacy. Our goal is to reduce the application rate and/or emissions from fumigation without affecting acreage.

The fumigation of post harvest commodities and structures can contribute to VOC emissions. We will be evaluating emission reductions from these fumigation practices.

Goal
The most direct way that VOC reductions can and have occurred is by reducing the reliance on fumigants, thus reducing the frequency and/or amount applied. Our long-term commitment is to work cooperatively with commodity groups and researchers on agronomically viable ways to reduce the reliance on fumigants. The advantage of pursuing a strategy that reduces the reliance on fumigants would improve exposure scenarios, reduce regulatory pressures and build a sustainable system for production agriculture. For the immediate future, we can achieve major reductions by limiting VOC emissions from fumigant applications. Changes to fumigant application practices can reduce VOC emissions by increasing efficiency and allowing a reduction in the application rates and/or reducing the amount of VOCs that emit from the soil column. Our approach will seek to ensure that agriculture's fumigation needs on an acreage basis are met while focusing on reducing the amount going into and coming off of treated acres.

Status
Data has shown that changes to fumigant application methods (i.e., deeper applications and sealing) can increase pesticide efficiency and therefore allow a reduction in application rates, thereby reducing the amount of VOCs that are emitted from the soil column. (For instance, one study indicated that a deep injection [20 or more inches] coupled with a very high barrier tarp treatment might yield a VOC emission of only 26 percent of the pesticide product applied.) Many fumigant registrants have submitted data documenting the VOC emission reductions achieved through changes in application practices since 1990. DPR staff is evaluating the documentation as a prelude to the building of DPR's fumigant emission reduction regulatory framework. DPR will be

evaluating application method changes and rate reductions with an eye toward developing specific regulatory measures. Some of the changes to application method may be commercially viable for the 2007 season, while other changes will require additional testing.

ISSUE A-1: Fumigant Emission Reduction Regulations

In 2007, we will propose regulations to reduce fumigant emissions (approximately four tons/day) based on the data we have available to date. As more data becomes available, we will refine the regulations to account for more fumigant emission and toxic exposure reductions. There are a number of application method changes that can reduce fumigant VOC emissions while achieving desired pest control goals (e.g., tarpaulins, soil amendments and adjuvants, shank injection, soil compaction, chemigation [drip irrigation—surface or buried—vs. sprinkler]). Many of the mitigation measures employed since 1990 have reduced VOC emissions but have not been documented or quantified. We will be developing regulations that *require* the use of specific fumigant application methods, or that *prohibit* some application methods (e.g., hot gas) to reduce VOC emissions. We expect to model the regulations after the methyl bromide regulations by placing general and minimum standards in regulations and by referencing the applicable permit guidance. We will be seeking additional information to identify application methods, reductions in application rates, and other pesticide use practices that reduce emissions from fumigant applications, either from individual applications or on a regional basis. The information will prove crucial as DPR initiates regulatory action to reduce VOC emissions from fumigants in 2007. We will base the regulations around the upcoming mitigation efforts being developed for MITC. In drafting the regulations, we will need to ensure that we do not limit innovative technologies and other VOC emission options. Additionally provisions of the regulations and permit conditions under consideration include:

- Feasibility and effectiveness of requiring fumigation chambers utilize best available control capture systems.

- Require licensed pest control businesses to employ best available application control technologies as a condition of licensure (e.g., impermeable films, irrigation management, soil amendments, adjuvants, etc.).

- Require anyone who conducts fumigant applications to possess a pest control operator's license, including private applicators.

- Further reduce methyl bromide seasonal risks from 9 ppb to 1 ppb.

ISSUE A-2: Future Fumigant Emission Reductions

Several approaches have demonstrated VOC emission reductions on small plots, such as the use of new types of tarpaulins and soil amendments and revised irrigation methods. These methods will be tested on commercial fields over the next few years. Although significant fumigant emission reductions will be gained from existing data, more reductions may be gained from additional research. In 2005, the California Strawberry Commission issued $500,000 in grants to research fumigant emission reductions. We are establishing a research collaborative with commodity groups like the California Strawberry Commission, the Air Resources Board and academia on fumigant emission reduction strategies.

Additionally, we need to develop a regulatory structure that facilitates the advancement of agronomically-sound emission reduction practices. Additionally, a number of fumigants will undergo a risk mitigation process to address toxic risks. As we incorporate toxic risk management into our regulatory program, we will account for VOC emission reductions. Some of the approaches to gathering more VOC emission reductions could be pursued by the following concepts:

- We could use as a limit, the fumigant emissions resulting from the 2008 regulations as a starting point to require fumigant registrants to develop a fumigant emission reduction plan. We could base the reduction on the amount of fumigant emissions in NAAs, certain regions of NAAs, or statewide. The limit will allow us to account for emissions while allowing for research to meet fumigation needs by lowering rates and/or emissions. The amount of treated acres would not be limited under this concept.

- DPR could focus fumigant registrants to develop a fumigant application rate reduction plan.

- DPR could require licensed pest control businesses to employ best available application reduction/control technologies as a condition of licensure.

ISSUE A-3: Reducing Fumigant Emissions During the Peak Ozone Season

Under the new SIP, we could place an emphasis on reducing the emissions during the peak ozone season (May through October) as a risk reduction approach. Such an approach would complement, but not replace, our overall efforts to reduce VOC emissions from fumigants. Pesticide VOC emissions are greatest during California's peak ozone season of May-October. Moving some fumigant applications outside of the May-October window would reduce the tons/day of pesticide VOC emissions during this critical period. DPR estimates that this measure will reduce VOC emissions by 0.8, 0.1, and 0.1 tons/day (3, 5, and 2 percent of the 1990 base year emissions) in the San Joaquin Valley, Southeast Desert, and Ventura NAAs, respectively.

- DPR could restrict fumigations in the San Joaquin Valley, Southeast Desert, and Ventura NAAs during the first two weeks of May and the last two weeks of October through regulation. DPR proposes to implement these restrictions for May and October fumigant applications.

- DPR would allow an exception for emergency/critical use based on factors that the risk of moving an application would pose a greater risk (e.g., soil moisture). The exception would be considered through the restricted material permit process. (All the fumigants are restricted materials; thus county agricultural commissioners would have the ability to exercise their discretion.)

Because fumigants are typically applied at high rates, the ability to move a limited number of applications outside of the emission inventory window can yield significant VOC emission reductions. Some fumigations are scheduled within the first and last two weeks of the VOC season could feasibly be moved outside the window. The existing methodology for calculating the VOC emission inventory will automatically capture temporal changes. Because the decision to apply fumigants—and the timing of fumigant applications—involves complicated issues, it is likely that most applications cannot be moved outside of the May-October window.

ISSUE A-4: Reducing the Reliance on Fumigants – Alternative Practices

Reductions in fumigant use can significantly reduce VOC emissions in certain regions of the state. A considerable amount of public and private research has been dedicated to reducing the reliance on fumigants, particularly methyl bromide. For example, DPR funded over $1 million of research on alternatives to methyl bromide from 1995 to 2000, in crops ranging from onions to strawberries. Nonfumigant alternatives shown to be at least moderately efficacious were soil solarization, crop rotation, biological control, resistant plant varieties, cover crops, organic amendments, and compost. These alternatives are most effective when used in combination and with an IPM system. No alternatives provide a one-for-one replacement for methyl bromide or other fumigants. Significantly more research is needed to advance the future of fumigant alternatives.

Soil Solarization is efficacious in hot, inland areas. Soil solarization is not effective in areas other than hot, inland areas. Growers consider solarization to be too labor-intensive and not as reliable as soil fumigation. Soil solarization takes arable land out of production for several months.

Crop Rotation can be an effective method of reducing damage to annual crops, and improve soil structure and fertility. Crop rotation requires time to be effective and a high cash crop (like strawberries) is usually rotated with a lower value crop (like broccoli). Some disease-causing organisms may survive for many years in the soil; crop rotation would be ineffective under these circumstances.

Biological Control. A great deal of information exists about biological control agents for the control of soil-borne diseases. Biological control agents provide only partial alternatives to fumigants since they do not control weeds or nematodes.

Resistant Plant Varieties frequently contribute to the control of many soil-borne diseases and pests. Resistant plant varieties can function in an effective rotational scheme. One of the major problems with resistant varieties is that many genes for resistance are only effective against a single pathogen or pest. Plant resistance to a disease or pest may not be available.

Cover crops. Many successes have been reported with the use of cover crops to control soil-borne diseases and pests. Cover crops do not control all soil-borne diseases or pests.

Organic Soil Amendments offer promising pest control results and can be considered a partial replacement for fumigants. Soil amendments must be chosen and prepared carefully so that disease is not exacerbated. The kind of organic matter in a soil amendment and its state of decomposition and/or microbial colonization determines the effectiveness of a soil amendment on root diseases. This balance can be difficult to achieve consistently.

Composted Organic Materials can effectively control soil diseases. The composting process must be carefully monitored for disease control efficacy.

ISSUE A-5: Reducing the Reliance on Fumigants - Quarantine/Sanitation Precautions

We could reduce some of the need for soil fumigation by enacting quarantine/sanitation precautions where soil samples have documented the presence of pests or diseases that can be spread by workers or equipment. For example, in some countries where fumigation is not allowed, workers must wear sanitary booties before entering fields to prevent the spread of pests or diseases. Information on regulatory support for this and other alternative soil pest management measures--based upon decades of experience--is available. However, depending upon the complexity of the measures to be enforced, and upon which crops and acreage will be affected, the effectiveness will need to be balanced against the cost.

ISSUE A-6: Reducing the Reliance on Fumigants - Preplant Fumigation

We could reduce fumigant emissions by requiring permittees to provide documentation on the need for fumigation based on soil samples showing unacceptable levels of pests or diseases, along with situation-specific documentation that no lower VOC emitting alternatives are feasible. The CAC would require the documentation as part of the permit application process, but would not be required to evaluate or reject the documentation. This approach would reduce unnecessary fumigant applications. Trying to require scouting and other threshold requirements may not be technically and scientifically viable and may result in adversely impacting crop production. Depending upon the complexity of the measures to be enforced, and upon which crops and acreage will be affected, meaningful reductions may not be achieved.

ISSUE A-7: Reducing the Reliance on Fumigants – Evaluate Economic Benefit of Preplant Fumigation

Improved and updated economic analysis of the value of certain fumigations may inform production agriculture's decision making regarding fumigation. Some information exists, according to Agricultural Research Service scientists, that the economic benefit of pre-plant fumigation for grapes and stone fruit is questionable in the San Joaquin Valley. In both crops, the nature of "nonspecific replant disease" is not well understood. Soil fumigation buys five years of vigorous crop establishment, but after that there is no yield increase from treatment. The more expensive fumigants, at least, may already not be cost-effective in stone fruit. While in most fields a crop pre-plant fumigation may have no economic benefit, it may be justified for particular fields. A more rigorous agricultural economic analysis would need to be conducted. We will pursue possible collaborative projects with commodity groups, the University of California, and the California Department of Food and Agriculture.

A-8: Fumigant Reactivity

Some data has been brought forward indicating that some fumigant may have low reactivity. Usually chemicals that have a limited potential to form ozone are exempted from air quality restrictions. As data are evaluated and more data are submitted, we will need to consider how fumigant reactivity will factor into our emission reduction strategy.

Lowering Emissions from Liquid Emulsifiable Concentrates

Background/Problem Statement
Liquid (nonfumigant) pesticide products, particularly those formulated as emulsifiable concentrates, rank second only to fumigant pesticides as the highest contributors of VOCs released into the atmosphere during agricultural and commercial structural-use pesticide product applications. Liquid pesticide products currently contribute approximately 40 percent of the pesticide VOC emission inventory for the San Joaquin Valley national ambient air quality standards NAA.

Goal
The management of pests can rely on a variety of pesticide products. The resultant VOC emissions from pesticide products comes from the VOC content of the product, the application rate, and frequency of use. One of our goals to reduce VOC emissions is to reduce the VOC content of products so that VOC reductions would occur even if application rates and frequencies remain constant. Other parts of our Pesticide Air Initiative will address approaches to reduce the rate and frequency of pesticide applications needed for pest management. We estimate that the reformulation of existing pesticide products--coupled with the development and implementation of VOC emissions criteria for new products--will result in an approximate two ton/day reduction in the San Joaquin Valley national ambient air quality standards NAA.

Status
Our initial effort was to establish a consistent data set on the VOC content of pesticide products. We found that many data gaps existed on the VOC content of pesticide products. On February 16, 2005, DPR issued a notice for the reevaluation for VOC emission potential data. During this data call-in, registrants were to submit thermogravimetric analytical (TGA) data that would be used by DPR to determine the VOC emission potential of each pesticide product for which the reevaluation was issued. Registrants for more than 500 products complied with the data call-in, but data for nearly 100 pesticide products was not submitted under the reevaluation. In April 2006, DPR announced the cancellation of pesticide products lacking TGA data. Since then, registrants for all of those products have responded to DPR and resolved their noncompliance by voluntarily canceling their product, supplying the data, or demonstrated that they were subject to the Air Resources Board consumer products rule.

On May 31, 2005, DPR initiated a second reevaluation to registrants, the thrust of which was the reformulation of certain pesticide products to lower the VOC emission potential of each product to no more than 20 percent. This measure focused on more than 700 products formulated as liquids. Registrants submitted responses to the reevaluation notice by March 1, 2006. We initiated cancellation actions against those products that failed to respond to the reevaluation notice. DPR staff are currently evaluating the responses.

By September 1, 2006, DPR staff will prepare an analysis of the reformulation reevaluation data that will include a timeline for requiring the use of new formulations for the reduction of VOC emissions.

By the end of 2006, we will complete our VOC reformulation review and develop regulations aimed at VOC reduction.

By June 1, 2007, DPR plans to implement regulatory measures for specific pesticide products. We expect to achieve a two tons/day reduction in VOC emissions from the reformulation regulatory process.

Regulatory Issues
Related to the Lowering of Emissions from Liquid Emulsifiable Concentrates: Reformulation and New Product Registration Criteria

ISSUE B-1: Reformulation

By the end of 2006, we will require some registrants to reformulate liquid emulsifiable concentrate pesticides into lower VOC-containing products. The reformulation of liquid emulsifiable concentrate pesticides into products with reduced VOCs could be accomplished using one or both of the following methods.

- We could identify the lowest VOC emission potential for each active ingredient in a liquid emulsifiable concentrate pesticide product and require all registrants of products containing the specified active ingredient to reformulate products to yield no more than the lowest emission potential identified.

- We could identify inerts with the lowest VOC reactivity rates and require registrants to reformulate their liquid emulsifiable concentrate pesticide products using low reactivity inerts.

Reformulation is a viable regulatory option that can realistically achieve VOC reductions for liquid, nonfumigant pesticides. Reformulation avoids unnecessary expansion of the regulatory process into the areas of pesticide use (i.e., use patterns/rates). Basing VOC reductions upon reformulation means that VOC reductions will be built into the product by the registrant, and not left up to the end-user. More consistent, predictable VOC reductions can be expected. Reformulation is one of the few options for which DPR can estimate VOC reductions with available data. Thus, VOC reduction via reformulation is achievable within the existing resource constraints of DPR. However, some products cannot be reformulated to reduce VOC emissions. To accomplish reformulation, registrants may need to conduct research (e.g., solvent selection, efficacy, acute toxicity, stability, phytotoxicity); gain federal and state regulatory approval; and modify production facilities and processes. These tasks take several years to complete and can be costly. We will need to ensure that inert ingredients of higher toxicity are not used when products are reformulated to reduce VOC content. We must make certain that application rates are not increased to offset the lower efficacy caused by lower VOC content. Registrants who reformulate their products may ask that their place in the market be protected. This could prove complicated and, ultimately, such protections could serve to drive up the cost of pesticide products (See Issue 5).

ISSUE B-2: New Product Registration Criteria

We will establish a requirement that would limit the VOC emissions from new liquid emulsifiable concentrate pesticide products. Two main options for achieving this goal are:

- Establishing a registration requirement that new liquid pesticide products yield no more than a specified amount of VOC emissions based on VOC content and rate/frequency of application.

- Establishing a registration requirement for new liquid pesticide products that limit formulations to the extent feasible (i.e., formulated with lowest VOC emission potential active ingredients, and low reactivity inert ingredients).

New products meeting a specified VOC limit (or those that emit less than the limit) will probably not require reformulation in the future. New products not meeting the specified VOC limit, but that are formulated to yield the least possible VOC emissions for their type, can be made available for use. This will enable pesticide users access to the chemical tools they require, while still limiting VOC emissions to the extent feasible. The VOC emissions limit will restrict new product registrations. Some new, highly effective products may not be marketable under the new VOC emissions requirements.

ISSUE B-3: Evaluation of Inert Reactivity

Reactivity refers to the ability of a specific chemical to create ozone. The amount of ozone created by different inert chemicals can vary by several orders of magnitude. If products could be formulated (or reformulated) using inert ingredients that are less reactive than the inert ingredients many products currently contain, this modification could reduce the amount of reactivity that occurs when pesticide applications are made and effectively reduce VOC emissions. We could require the reformulation of products with highly reactive inert ingredients. A regulation that directed the formulation of products with less reactive inert ingredients would be a positive step toward potentially reducing VOC emissions. Although we support the concept of not formulating (or reformulating) pesticide products using highly reactive inert ingredients, a number of barriers exist to pursuing this concept. Reformulation of pesticide product inert ingredients would require a large resource commitment from pesticide registrants. The process would be time-consuming and expensive. DPR resources are not adequate to evaluate product modifications and new emission potentials.

ISSUE B-4: Low Vapor Pressure Exemption

In response to DPR's reevaluation notices, registrants noted that many products have changed formulations since 1990. The formulation changes have included many compounds that are exempt from ARB's consumer products' inventory due to low vapor

pressure, but would be captured as a VOC based on a TGA analysis, and not exempt by DPR. The registrants are requesting that we accept the Air Resources Board's (ARB's) exempt materials list in determining the VOC content of products. We are considering a low vapor pressure exemption, consistent with ARB requirements. Our adoption of the low vapor pressure criteria would be consistent with ARB's consumer products program. This would document registrants' change to lower volatility solvents in some cases. As we move forward we may not be able to identify the inert ingredients of products used in earlier years, particularly the 1990 (or 1991) base year. The vapor pressure for these products cannot easily be determined.

ISSUE B-5: Regulatory Consistency

When a registrant offers to reformulate a pesticide product to reduce VOC content, how should DPR ensure that an even regulatory playing field occurs by ensuring that competitors meet the same standard? There are instances where competing products are labeled for generally the same crops and for the same pests. Without any assurance that the investment into new product formulations will drive the market, registrants will be unlikely to advance solutions and invest in innovative technologies. We are considering using our regulatory authority to limit the availability of high VOC-containing products in cases where lower VOC products are brought forward. We can more reliably predict VOC emissions when products meet a standard and will make the reevaluation process enforceable. The consistency will provide an incentive and assurance to companies that their investment into the development and introduction of lower VOC product formulations will be protected.

ISSUE B-6: Limit to Critical Uses

Our discussions with pest management specialists indicate that emulsifiable concentrates may be critical for controlling certain pests on certain crops, but not all. Pesticide product labels may allow for a wide spectrum of uses, not all of which rely on emulsifiable concentrate formulations. We are considering various options to allow limited uses of emulsifiable concentrates for critical needs. We could have registrants voluntarily change their labels to remove uses not reliant on emulsifiable concentrates. We could establish prohibitions for certain uses in regulations. One advantage to this concept would be the limitation of emulsifiable concentrates to critical needs. Such a process would make it easier to remove uses that are not critical. A number of problems exist for implementing this concept. First, DPR does not have legal authority to change pesticide labels. Secondly, statewide regulations would be difficult to craft for this issue.

ISSUE B-7: Prioritize Label Amendments

Emphasize and expedite label amendments of registered products (low-emission VOC products and VOC alternatives) for use on a new site (agricultural vs. nonagricultural) or commodity, (e.g., amend the label to allow liquid ant bait to be used in agriculture). Instituting this measure would quickly and easily add effective, low VOC emission products for use in agriculture.

Reducing VOC Emissions by Changes in Pest Management Practices

Background/Problem Statement

In general, the best approach to managing pests and reducing risk is through integrated pest management (IPM). IPM is a systems-approach based upon monitoring for pests and natural enemies and intervening only when pests reach a level high enough to cause economic damage. Intervention includes integrating a wide-range of biological and cultural controls and selective use of pesticides when necessary, in a way that results in the least possible harm to nontarget organisms and the environment. To date, the consideration of air quality impacts has not been a major factor in IPM and other agronomic considerations. The success that IPM has had in addressing other environmental issues lends optimism for achieving significant improvement to air quality. In making any changes to pest management practices, achieving desired pest control must be maintained. Thus, reducing use of high VOC pesticides can be achieved if effective and economic alternative methods of controlling these pests are available.

The research into commodity varieties that are resistant to key pests can reduce the reliance on pesticides. The result in pesticide VOC reductions could be significant, especially if the commodity was resistant to pests requiring fumigation. Various commodity groups, researchers, and the University of California develop long-range plans for commodity research priorities. As part of our strategy, we will promote the importance of the development of commodities that are resistant to pests, especially those pests that require fumigation.

The overall success of our strategy could be damaged if new pests are introduced into California. We have seen new pests disrupt many pest management systems and have caused an increase in pesticide use. As part of our strategy we will offer support to the California Department of Food and Agriculture, the county agricultural commissioners, and the U.S. Department of Agriculture for their efforts to prevent the introduction of exotic pests into California.

Goal

To incorporate air quality considerations into IPM and other agronomic approaches, and to find the means of adopting the practices. Because IPM is dependent on the characteristics of the pests, natural enemies, crops, and the environment, IPM approaches must be tailored to each particular situation. In this discussion, only general strategies will be described that may or may not be applicable to specific pest-crop combinations.

Status

Some of the strategies discussed are based on extensive research and experience and are known to be effective and economical. These strategies may not be widely used because growers or pest managers are not aware of the strategies, are not convinced the strategies will work in their situation, or because their current methods of managing pests are effective and they see no reason to change. The value of other strategies may be less certain, but can be considered as potential options depending upon further research and experience. The distinctions between these two groups of strategies, those based on extensive research and proven to be effective vs. those still in the experimental phase, are

indicated below. We must first understand what paths are possible and needed. We will be working with research and commodity groups for an evaluation of the areas where VOC reductions are practical and where partnerships may be needed to achieve our goals.

ISSUE C-1: Strategic Partnerships

Any change to the wide spectrum of California's complex pest management systems will require analysis, research, and outreach. A number of strategies will be pursued to foster changes in pest management. We will be looking to commodity groups for analysis of near- and long-term changes to their pest management system that may be agronomically viable. Commodity groups and the University of California have begun preparing evaluations on the key pest management practices utilized by the commodity and the potential options for reducing VOC emissions. To fully capitalize on potential pesticide VOC emission reductions, we will seek to establish strategic partnerships with commodity groups. The strategic partnerships could involve collaboration on technical assessments, developing an implementation strategy, and cooperating on financial assistance for research and implementation.

The success of strategic partnerships will require the investment of resources for demonstration and implementation. Historically DPR has had a successful grant program that developed and promoted IPM systems that reduced or completely prevented environmental pollution from pesticides. Due to budget constraints, funding for that IPM program was suspended in fiscal year 2002-03. We could reestablish and improve the Pest Management Alliance grant program focusing on developing and implementing IPM systems that reduced air emissions. However, a secure funding source for a new Pest Management Alliance program would need to be identified. The DPR Fund may be a source of funding once the fund has an adequate reserve. Alternatively we could leverage other grant fund/bond funds from the State Water Resources Control Board, U.S. Environmental Protection Agency Region IX, U.S. Department of Agriculture, and others. This would be similar to the Food Quality Protection Act and Pesticide Environmental Stewardship Program grants directed by DPR that resulted in seasonal IPM guides for stone fruits and almonds.

Other strategic partnerships could involve working with third party certification programs. For example, we could collaborate with Protected Harvest and Food Alliance to promote sustainable farming practices and reduce pesticide use through IPM adoption. VOC reduction goals could be a component in "IPM" certification programs. DPR would collaborate by providing pesticide use report (PUR) analysis, pesticide registration assistance, and documentation of grower program compliance. This would result in additional information on viable alternatives to pesticides. An obvious partnership could be made with the U.S. Department of Agriculture's Natural Resources Conservation Service/others. We could assist the Natural Resources Conservation Service with pest management expertise to foster grower use of the Environmental Quality Incentive Program and the Conservation Security Program to reduce pesticide use. Growers could be encouraged to incorporate IPM plans into their operations by payments or cost sharing

for additional monitoring, new equipment, or the cost of reduced-risk (low VOC) pesticides outlined in the plans.

ISSUE C-2: Pest-Resistant and Pest-Tolerant Crops

Different varieties (cultivars) within any crop differ in the way they support the feeding and reproduction of pests. Most fall somewhere between the two extremes of susceptibility and resistance. Plants can, for example, demonstrate chemical or physical resistance to pests through the production of secondary plant chemicals that repel a feeding pest, or by possessing small, irritating hairs that prevent insects from feeding. Plants can also express tolerance to feeding; that is, some plants can still yield a good crop despite pest damage.

A quick review of pesticides and their commodities suggests that the fumigants 1,3-dichloropropene, methyl bromide, and chlorpyrifos are major contributors to VOC emissions. Fumigants target nematodes that may infest almond, grapes, orange, walnut, and carrot. Chlorpyrifos is often used for homopterans (aphids and scale insects) on cotton, orange, almond, and walnut; it is also used periodically for lepidopterans such as navel orange worm or peach twig borer on almond.

Research on how plants withstand nematode feeding often focuses on the evaluation of resistance and susceptibility of rootstocks to different nematode species. Research of this type is more common for nematode resistance than for insect resistance. The use of resistant rootstocks is compatible with other reduced-risk practices such as sanitation, soil solarization, and organic amendments.

Resistant cultivars have a good track record of reducing infection from soil-borne diseases and nematodes, and infestations from above ground pests. Resistant cultivars can be used in conjunction with other reduced-risk practices such as sanitation, soil solarization, and organic amendments. Resistant cultivars are cost effective; the cost of breeding is less than the cost of applying pesticides. However, resistant cultivars are generally not embraced by packer–shippers because, although pest-resistant, the cultivar may not produce a crop that can stand up to the rigors of handling. Resistant cultivars may be more expensive than nonresistant cultivars. For some crops and pests, no resistance characteristics may exist. Development of new resistant varieties can take many years. In pursuing this issue, we will need to establish new relationships with commodity research entities.

ISSUE C-3: Supporting Pest Exclusion

IPM practices are sometimes disrupted when a new pest enters a region. These new pests often cause extensive damage and can be difficult to control. Thus, it is important to have strong measures in place that keep potential new pests from entering California. As part of our long-term strategy, we will look to create partnerships with the California Department of Food and Agriculture, the County Agricultural Commissioners, and the

U.S. Department of Agriculture to emphasize the environmental importance of pest exclusion.

ISSUE C-4: Require Alternative/Best Management Practice Evaluation as Part of Restricted Material Permitting

The pest control advisors (PCA) provide an important foundation to pest management decisions in California. They are required to evaluate alternatives and provide recommendations to growers. We could develop the education needed to pest control advisors so they may make informed decisions about high VOC pesticides in California crops. Ultimately, we could require pest control advisors to include on their pesticide recommendation form acknowledgement that the lowest VOC pesticide was considered, as well as the identification of equipment that reduces VOCs emissions and pesticide use. The regulatory framework for restricted materials already requires that consideration of alternatives be considered. One potential source of information that could be relied upon by PCAs are the University of California's IPM crop-specific Year-Round IPM Program with its Annual Checklist of Best Management Practices. The reference to this and other sources could be a prerequisite for a restricted materials permit. Providing the IPM program is followed, pest control advisor's (PCA's) crop monitoring records—together with receipts for purchase of monitoring traps and other Best Management Practice supplies and/or documentation of lack of feasible alternatives—could demonstrate "critical need" for high-VOC pesticides. University of California IPM guidelines prevent pest buildup, use economic thresholds for pesticide application decisions, and give preference to environmentally friendly pesticides.

Under this concept the best available science would govern pest management decisions and would not preclude the use of restricted materials, provided an evaluation was conducted. By targeting Best Management Practices as part of the restricted material permit process will also focus on the most toxic pesticides. Following the University of California IPM guidelines would enhance prospects for a proposed DPR collaboration with the U.S. Department of Agriculture's Natural Resources Conservation Service in order to make financial support available to growers who use the University of California IPM Year-Round Program as the basis for implementing Best Management Practices that reduce air pollution. Some barriers and concerns exist to this concept. First the role of the CAC would need to be defined in terms of determining compliance. The CAC would be limited to ensuring that the PCA had some documentation, but not necessarily the requirement to assess the decision. Furthermore, the most appropriate permitting juncture for preplant fumigation and in-season pesticide application would have to be determined. Permits are currently issued for up to three years in perennial crops like orchards. This permitting approach would have to be modified to accommodate three year permits.

ISSUE C-5: Information Driven Pest Management

Under pressure to comply with governmental health and environmental regulations, growers need a tool to assess the impact of their current pest management practices, as well as a method to evaluate existing alternative pesticides and pesticides newly registered for use. If this information could be easily obtained and understood, growers would be able to effectively transition away from high VOC emission pesticides to the most efficacious low emission alternatives.

Through research and database creation by many different organizations over the years, a wealth of information has been generated on various aspects of the environmental and health impacts of pesticides, such as emission rates, indices on toxicity, efficacy, and use rates. Each of these measures is limited, however, in not being able to create the complete picture of impact and efficacy that a grower, advisor, or regulator would need to make the most effective pest management decisions in complying with low VOC emission and water quality regulations. An interactive Web site could integrate available knowledge on environmental risks associated with the use of pesticides and the emission rates, toxicity, efficacy, and cost of pesticides. The Web site could be designed to allow the user to make smart decisions ensuring crop protection and reducing environmental impacts.

Such a Web site could allow a grower to enter specific details of his/her growing situation and receive a detailed, easy to understand analysis of efficacy, cost, and the environmental impact of various technologies currently available. Environmental impact could be further broken down into VOC emission potential, water quality impact, and toxicity and environmental impact risk values from various models, so the grower can clearly see where impact is greatest, and access alternative solutions provided by the Web site to reduce the impact to a level below the concern. The compiled information and evaluation of the environmental risk models will be useful to growers, advisors, regulators, and researchers.

ISSUE C-6: Affect Change in Commercially Driven Pesticide Use

Many pesticide applications are required by lending institutions, landholders, and insurers as a means of reducing potential risk of crop failure. Many pesticide applications could be avoided without affecting production through the lessening of requirements by these institutions. We will need to assess the roles of agricultural lenders and insurers, shippers, and exporters in decisionmaking about the use of fumigants and other high-VOC pesticides. Findings and analysis of this assessment could form the basis for constructive change through negotiations and/or regulation.

Adoption of Innovative Technologies: Precision Agriculture

Background/Problem Statement
The term "precision agriculture" refers to better targeting of farm management practices, to make them more efficient. Precision agriculture technology allows users to tailor farm management practices to address the variability within their fields or orchards. These technologies may be employed in our short- and long-range plans to reduce VOCs from pesticides. These technologies encompass both those that are ready for field use as well as technologies that are still in development. Technologies relevant to reducing use of pesticides that contribute to VOCs while maintaining effective pest control include: (1) ground equipment designed to apply pesticides more efficiently and/or reduce waste; (2) variable rate application technologies, and (3) remote sensing and mapping that may reduce the number of pesticide applications or the area of application.

Goal
The goal is to find new technologies that will effectively and economically manage pests at acceptable levels while using less pesticide. Once we have developed the means of identifying the technologies, we must find ways to promote their adoption.

Status
Some of the new technologies discussed are based on extensive research and experience and are known to be effective but may not be widely used because growers are not aware of them or because they require a high initial financial investment. DPR staff have identified three general classes of innovative technologies that could reduce VOC emissions, drift, and pesticide use in general.

Precision agriculture technologies
(1) Ground equipment designed to improve application efficiency and reduce waste include:

- Special nozzles such as Spray Redux double nozzle sprayer, low and high pressure venturi air induction nozzles (Air Bubble Jet, Airmix®, TurboDrop®, AI TeeJet®), and TwinJet Twin Flat Spray Tip.
- Electrostatic spraying systems that produce small, negatively-charged spray droplets.
- Positive shutoff valves that prevent pesticide leakage, e.g., the drip-free shutoff (Western Farm Service, ChemSaver®), and many others.

(2) Variable rate technologies designed to change the rate of application according to information gathered in the field include:

- Operator-controlled rate adjustment systems enable the operator to control spray pressure and flow rate, for example, the Aim Command (Case International) and Synchro (CapstanAg Systems).
- Spray equipment with built-in sensors that operate continuously as the equipment moves through the crop, for example "SmartSpray" technology and Weed Seeker®.

(3) Remote sensing and mapping technologies that can reduce the number of applications or reduce the application area. This suite of technologies incorporates remote imaging,

geographic information systems (GIS), and global positioning systems (GPS) to identify anomalous patches of crop disease, insect, and/or weed infestations.

ISSUE D-1: Identification and Adoption of Innovative Technologies

These technologies may be immediately employed with substantial benefits in specific settings. However, three general barriers prevent their wide spread adoption. First, knowledge of which equipment will meet risk reduction goals is lacking. Second, the initial investment cost for the purchase of new equipment. Third, some technologies are applicable only to specific crops, cropping systems, and may not be applicable to all classes of pesticides. We will begin this effort by attempting to inventory the types of equipment and technologies that are readily available in the marketplace. Over time, we may need to establish a process for certification of equipment. After the initial equipment identification process is set, we can explore the means of providing incentives and potential requirements for the adoption of the technologies.